

Bilateral Collaboration Fosters Advances in Neutron Capture Therapy Research

The U.S. Department of Energy's (DOE) Idaho National Laboratory (INL) announced Feb. 9, that the laboratory is entering its seventh year of collaborative research with the National Atomic Energy Commission of Argentina (CNEA) on experimental treatments for a lethal form of brain cancer and other malignancies. The project is funded through the DOE's National Nuclear Security Administration (NNSA).

"Scientists at INL have been researching these techniques for some 20 years," said Dave Nigg, the scientist who has overseen Boron Neutron Capture Therapy (BNCT) research at INL since 1994. "We are excited to have the opportunity to continue on in this vital area of research."

Boron Neutron Capture Therapy has commanded the attention of scientists worldwide for a number of years as a promising experimental cancer treatment. One of the two naturally-occurring isotopes of boron, boron-10, strongly absorbs neutrons. By attaching isotopically separated boron-10 to a biochemical agent that has an affinity for cancerous tissue, it can be ideally delivered through the blood straight to cancerous cells. The tumor is then exposed to a beam of neutrons. When a neutron collides with a boron atom, an alpha particle and a lithium ion are produced. These highly energetic charged particles travel distances comparable to the size of a tumor cell, depositing energy as they slow down. This leads to selective destruction of the tumor cells and spares the neighboring normal tissue. In other words, the boron-carrying cancer cells are killed by exposure to high radiation doses, yet the surrounding healthy tissue receives a significantly lower radiation dose. BNCT is thus similar to molecular targeted radioisotope therapy, but with the added advantage of an "on-off" switch to control the healthy tissue dose.

The new work in this important field of nuclear medical research will be conducted under the terms of the US-Argentina arrangement for "Technical Exchange and Cooperation in the Area of Peaceful Uses of Nuclear Energy" that was signed in October 1997. This Sister Laboratory Agreement involves a number of U.S. and Argentine research institutions involved in several different types of scientific studies. The INL participates in the BNCT area of the program. Additional matching support for INL BNCT activities in earlier years under the Sister Laboratory Program also was provided by the DOE Office of Science.

Article IV of the Treaty on Non-proliferation of Nuclear Weapons (NPT) calls upon all parties to the Treaty to facilitate the fullest possible exchange of equipment, materials, and technical information for the peaceful use of nuclear energy. NNSA's Sister Laboratory Program is one way the United States meets these obligations. Bilateral arrangements have been established between the NNSA and partner nuclear research institutes in selected foreign countries, including Argentina, for technical assistance and information transfer.

Photo: Dave Nigg

Dave Nigg has led BNCT research at INL since 1994. Research at INL over the last 20 years has made significant contributions to the BNCT field.

Photo: Radiation dosimetry software

The Sister Laboratory Program has been of tremendous value for both sides. The BNCT area has achieved its objectives on every front, and the technology transfers, personnel exchanges, joint publications and other activities that this program has enabled have set the stage well for possible expanded future INL collaboration with CNEA.

BACKGROUND:

Research at INL and various collaborating institutions in neutron dosimetry and neutron source engineering, biophysics, radiobiology, and boron chemistry has added significantly to the pool of knowledge in BNCT. BNCT-related activities under the Sister Laboratory collaboration have included a number of visits by INL scientists to CNEA research facilities in Buenos Aires as well as San Carlos de Bariloche for presentation of seminars, technical training courses and collaborative experimental work in chemistry and medical radiation dosimetry. In addition, an Argentine graduate student visited Idaho Falls for a period of time to work with INL experts in analytical boron chemistry.

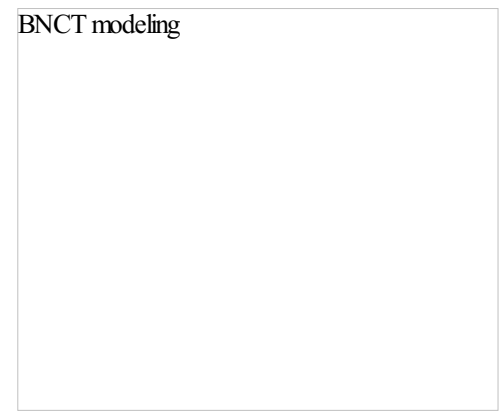
Three-dimensional dose contouring using radiation dosimetry software

More specifically, the collaboration has involved experimental dosimetry and neutronic characterization of three reactor-based neutron sources used for BNCT research in Argentina, development and implementation of state-of-the-art experimental techniques for analytical chemistry, and a multiyear joint effort in BNCT preclinical radiobiology studies using mixtures of boron delivery agents having complementary uptake mechanisms. One of these agents is synthesized using a process that is partially based on technology developed and patented by INL. The researchers have published their work at many international conferences over the years, as well as in several referred journals, most recently in the prestigious journal *Radiation Research*. This collaborative effort has contributed to the understanding of the radiobiology of BNCT, to improving the therapeutic efficacy of this technique, and to extending its potential application to the treatment of oral cancer and, more recently, to liver metastases, which will be the primary subject of work conducted during 2007.

General Contact:

Teri Ehresman, (208) 521-9882,

[Feature Archive](#)



Treatment planning for BNCT includes modeling and rendering on multiple layers.